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ABSTRACT

An interactionist-discovery theory of child phonology is proposed based on the following tenets: children invent their own phonological rules, and phonetic mastery is not automatically or generally in step with learning about phonemic contrasts. When a child learns the sound pattern of a language, there is constant interaction between the structure and that which is structured, and there is active discovery of the structure. Evidence is principally drawn from a recent longitudinal intensive case study, but independent support is also cited. Based on the case study, two modes of rule formation are discussed. The first rule invention is essentially a generalization process that can be interpreted as a carrying over of articulatory habits from one or a few established words to new words. In the second rule invention that occurred with the child, two different but similar output (surface) patterns coalesced or consolidated with one another. There were several different cases of rule formation by consolidation, and two of them are discussed. Evidence from the child concerning the early development of phonemic patterning is cited, and the phenomenon of the selective avoidance of certain sounds by some children is discussed. (SW)

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EVIDENCE FOR AN INTERACTIONIST-DISCOVERY THEORY OF CHILD PHONOLOGY *

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This paper does not present a unified theory of the acquisition of phonology in the sense that the claims follow from a single set of assumptions; one might consider it a theoretical approach. The interactionist-discovery theoretical approach, then, has the following tenets:

1. children invent their own phonological rules
2. phonetic mastery is not automatically--indeed, not generally in step with learning about phonemic contrasts.

While these and other aspects of the interactionist-discovery approach are logically independent, they are related in that they are both harmonious with the same basic conception of the language-learning child. This child is first an active imposer of structure, an organizer, and a constructor. Second, he takes the language 'out there' as his starting point, not merely as an end point to be reached after an internally-governed evolution. And third, the typical, but not only learning procedure is the mastering of special cases and then finding of patterns to tie these cases together; it is not like the standard model of learning by first making crude distinctions and then finer and finer ones. The child's problem is basically one of organizing the plethora of distinctions that he can apprehend into chunks he can handle, but he has to start with those distinctions; he does not have ways of chunking them automatically available.

If I dignify this broad characterization of the child learning language with the name 'theory', it is to emphasize what has been neglected in some earlier characterizations that also have occasionally borne the name of 'theory'. The child learning the sound pattern of a language does not behave as an automaton any more than the child learning syntax. There is constant interaction between the structure and that-which-is-structured, and there is active discovery of the structure. These claims are counter to the most widely known theories of the acquisition of phonology, those of Jakobson and David Stampe, which claim that the child's phonemicization of his language and the occurrence of child-phonology rules are 'natural' unfoldings, growing like the limbs of an embryo.

My evidence is principally drawn from my recent longitudinal intensive case study (Menn, 1976), but independent support comes from earlier work, especially Ferguson and Farwell (1975), and now from two studies in this volume, Farwell (1976) and Vihman (1976). The reader is also referred to Drachman (1975), and Kiparsky and Menn (1975). I will establish

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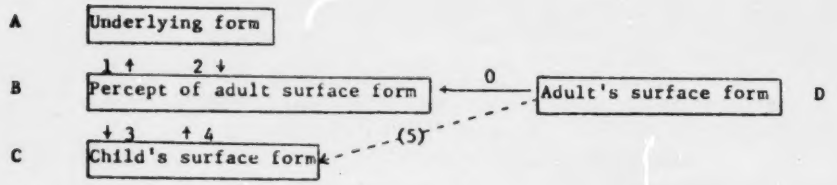
some terminology before presenting evidence and argument. I am working with the conceptual framework represented by the schema of Figure 1.



0. D→B: Child, in taking in the adult form, imposes some structure on it

1. B→A: Child eventually constructs abstract representations tying together related morphemes (for very young child, A = B)

2. A→B: Rules of general phonology can be formally stated to derive produced adult surface form from abstract underlying from (simplifying assumption: for adults, B, C and D are identical in information - i.e. the adult speaks as he/she hears other speak and as they in fact do speak)

3. B→C: Rules of child phonology can be stated formally to capture the strategies which the child adopts for producing vocalization to represent adult words

4. C→B: Varying degrees of feedback from the child's own output exist

(5) D→C: For convenience, rules of child phonology are often written as direct rules mapping adult surface to child's output

Figure 1. Schema of levels of representation (adapted from Kiparsky and Menn 1975)

Some further elaboration of theoretical levels is probably required for a full description of early phonology- I am in essential agreement with the proposals of Ingram (1974)- but we can describe the main portion of the rules of child phonology by considering the levels here. 'B' is the child's percept of the adult surface form, or better the information about the sound and meaning of a word that enables the child to recognize new instances of the word when he hears them. The level labeled C is the output representation of the word, the child's encoding of articulatory instructions for saying the word. The rules of child phonology as written for convenience usually make direct correspondences between the adult model word and the child's input, e.g. duck [g^k], bypassing

the question of inferring the child's underlying form, but for coherent theorizing, we cannot take this shortcut. I will use the term 'rule of child phonology' only to refer to the links between the child's percept of 'the' adult form of a word and his production of that word.

Rules of child phonology are distinct from the phonological rules of the ambient language, which the child will discover in more and more detail as he learns the patterns that relate the morphemes of the language. Rules of child phonology capture formally the strategies which a given child has adopted to ease the formidable task of producing vocalizations to represent the adult model words, bur rules of general phonology are conceptually very different entities: they and the abstract underlying form (level A, figure 1) are formalizations of the patterns which speakers can abstract from their language. For the very young child, the underlying form is not distinct from the percept of the adult surface form--at least I assume that it takes some time after the initial apprehension of a set of adult words to make out the patterns that they fall into.

In the beginning speaker I have just studied, named Jacob, two different modes of rule formation were visible.

One of the modes of rule invention that I saw is quite expected and straightforward. It is essentially a generalization process which can be interpreted as a carrying over of articulatory habits from one or a few established words to new words. (Higher levels of organization are probably also involved.) There were several cases: a good one was Jacob's carryover of a phonotactic pattern 'words begin with [d]' from most of the handful of words he produced at age 14 months: this generalized to give a /b/→[d] rule, an /n/→[d] rule, and sporadic initial [d] on 'round' and 'uh-oh'. This sort of rule appearance seems fully analogous to the way one who is learning a second language carries over into it the surface patterns of his own language--like an American aspirating initial unvoiced stops in French or a German devoicing final stops in English.

It is certainly not the case that this 'words begin with [d]' rule, in its various manifestations, was 'available' to Jacob automatically, for he began without it: his fourth word was 'no', with initial [n], but later he did apply the rule to 'nose', saying [do].

The second mode of rule origin which I observed in Jacob was completely unanticipated and is much more exciting. It is a high-level phenomenon, not subject to any articulatory explanation. In such cases, two different but similar output (surface) patterns, <u>both of which Jacob had learned to say</u>, coalesced, consolidated with one another. There were several different cases of rule formation by consolidation in the Jacob corpus, and I will discuss two of them here. The first case, involved the words 'tape' and 'tea'. Jacob began to learn them both at about the same time, and varied between an [ej] vowel and an [i] vowel for both of them. Then he settled down to [ti] for both words--formally speaking, a rule taking /ej/ to [i] was invented, and it generalized to new instances in certain phonetic contexts: gate [gi], cake [ki:k].

The second case of rule origin via consolidation is more spectacular. Jacob has a Greek-born babysitter from whom he picked up the lexical item 'kaká' = feces, soiled diaper. (No other effect of the sitter's native language was visible in Jacob's speech.) Jacob had no other CVCV words stressed on the second syllable. At the time when Jacob first began to say 'kaká', he was producing two other words of the shape kVkV, 'cookie' and 'cracker' (see Table 1). Over the next several weeks, changes took place in these words. For a while he wasn't using 'cookie' and a final

Table 1. Interaction of kaká and cookie/cracker

kaká	(kaká) (date unknown)	(kaká) 18:27	káka 19:24	kaká 19:27 káka 19:27	káka 20:22
cookie	(kúkɨ) 18:18	kaká (date unkown)	kʌkí 19:24	kʌkí 19:27	kúki 20:18
cracker	káka 17:11			kúki 19:27	

(Parenthesized entries were imitated)

stress appeared on 'cracker' so that it became a homonym with 'kaká'. Then Jacob began to use 'cookie' for both cookies and crackers; 'cookie' showed up also with a final stres, and at the same time, 'kaká' appeared with initial stress. A little later, on a single day both forms were found for 'kaká', while 'cookie' was produced spontaneously with final stress and in imitation with correct initial stress. Finally, the conflict was resolved, two months after the first attestation of 'kaká': both 'cookie' and 'kaká' stabilized with initial stress, and at that point the generalization held that all CVCV words had initial stress in Jacob's output.

This evidence that rules can arise from reorganization of existing ways-of-saying words is doubly exciting because it also suggests one way that phonemic patterning might emerge: a child might start by learning a set of phonetic targets word-by-word, and later reorganize them into phones and phonemes. Clear evidence that such a process has taken place in some child is not available, as far as I know, although Jacob might have done something of the sort and so might the subjects in Ferguson and Farwell. I think conclusive evidence of such a process of phonemicization taking place is an important thing for child phonologists to look for.

Let me turn to the evidence that is available from Jacob concerning the early development of phonemic patterning. It has been repeatedly pointed out, at least since Moskowitz (1970), that although we must not abandon Jakobson's fundamental insight into the role of the notions feature and contrast in acquisition of phonology, there are deficiencies in his model. The argument made by Moskowitz, and also used by Ferguson and Farwell, is that a theory concerned only with the acquisition of feature contrasts does not possess the machinery to deal with one very salient fact about both child language and the languages of the world: features do not combine freely. For example, a language may, like English, have both velars and fricatives, but not velar fricatives; a

child may be able to say initial [b] and both initial [t] and initial [d], and yet not have initial [p]. Markedness theory, partially descended from some of Jakobson's work on implicational heirarchies among features, attempts to cope with such facts, but this remains a difficult area. A central problem with the Jakobson model arises from the inherent duality of the notion phoneme: a phoneme is on the one hand an element in a grid of features, but it also is manifested in a class of phonetic realizations. Both form and content must be reckoned with, both pattern and sound.

Let us examine one phenomenon which shows us clearly that the study of the acquisition of contrasts does not tell enough of the general story of the acquisition of phonology. This is the phenomenon, unknown to Jakobson 35 years ago, of the selective avoidance of certain sounds by some children. Ferguson and Farwell (1975) suggested that this occurs in some children, and Farwell's present study (sec. 3.2 of her paper in this volume) describes one case in detail and mentions two others. Vihman's subject (this volume) characteristically avoided problematic sound patterns, and so did my subject, Jacob.

In the early months of his speaking-life, Jacob's only regular initial stop consonants were coronals (there were two words not admitting analysis into segmental units, CVCV shapes which had free variation in the stops among dental, palatal, or velar output--see Menn (1976)). At first, then, he avoided adult words containing either labials or velars; then he learned to produce k, then b; at the end of the study he had, in initial position, [b], [d], [t], and [k], but avoided attempts at adult words (well attested in his passive vocabulary) beginning with g or p.

Now the first and most stunning implication of finding that some children avoid saying some sounds, and conversely choose to utilize sounds that they can render rather accurately, goes well beyond the parochial concerns of phonological theory. An unforeseen degree of feedback, of awareness of one's own production ability, of self-consciousness, must be invoked to explain selective avoidance. Our notion of the language-learner must be elastic enough to include Jacob, who seemed acutely conscious of the quality of his initial stop consonants, and the now-legendary child who insisted "But I did say fiss!" Sometimes children hear what they say, and at others they seem deaf to the discrepancy between what they intend to say and what they actually say. Of course, we needed this variability of feedback in acquisition theory all along, to account for the 'terraced' look of acquisition: stable periods alternating with periods of rapid change.

But selective avoidance is not only important for the change it brings about in our intuitive notion about the child's potential for awareness of his output. It also provides one of the clearest arguments for the claim that acquisition of phonetic control and of phonemic structure are separable strands of development. Let us consider Jacob at 15 or 16 months: he had no adult words beginning with /b/ in active vocabulary, but he had a number of words beginning with dental which he rendered fairly well. There was certainly no confusion of labial with coronal articulation, i.e. no merger of b and d in production. Jacob honored the phonemic contrast between b and d in English by avoiding words beginning with b and not words begi-ning with d, and he also showed his phonetic knowledge of d by producing it accurately (see Table 2).

Table 2. Phonetic vs. phonemic knowledge

Jacob: avoids b-initial words
says d-initial words accurately
therefore knows: adult b contrasts with adult d (phonemic knowledge)
how to say d (phonetic knowledge)

C_1: avoids b-initial words
says d-initial words with a wide varity of b-like and d-like sounds
therefore knows: adult b contrasts with adult d (phonemic knowledge)
does not know: how to say b or d (phonetic knowledge)

C_2: produces good tokens of b and d, but uses them indiscriminately for either adult b or d
therefore knows: how to produce b and d (phonetic knowledge)
does not know: that d and b contrast in English

This state of knowledge is in contrast with that of a hypothetical child C_1 who might have the same knowledge of English structure and avoid b, yet lack the phonetic knowledge and produce a wide variety of sounds as tokens of English d. It also contrasts with the state of knowledge of a second hypothetical child C_2 who might have considerable phonetic skill and produce nice neat b and d tokens, but yet not realize that they stand in contrast in English and so would use them interchangeably.

The lesson here from the phenomenon of selective avoidance is that we must conceptualize and describe the phonetic and phonemic knowledge of a child as separate, although related, facts in order to discriminate the different states of affairs represented by Jacob, C_1, and C_2. Let me add at this point the evidence that I have which shows that Jacob is correctly described as avoiding b deliberately, rather than simply ignoring it in favor of d. Recall that Jacob had a single instance of a /b/→[d] rule: 'byebye' as approximately [dæ dæ]. For over three months after he began to say this version of 'byebye', he had no other labial initial word in his active vocabulary, though he occasionally imitated a few. On the other hand, he had quite a handful of such words in his passive vocabulary: 'ball', 'box', 'bang', 'block', 'boot', 'bounce', 'bottle'. When he first started to produce b, around 19 months, he began to say these words for the first time. A number of them made single appearances with initial [d] before settling down to the correct initial [b], and one of them, the very important word 'ball', not only first showed up with initial [d], but also maintained that [d] in frequent use over several weeks, until after 'byebye' itself had been corrected. The only coherent explanation I can come up with for this appearance of a /b/→[d] rule after Jacob had learned to say [b] in 'baby' and other words correctly is that Jacob had formed a latent output representation of these old words, a representation with initial [d]. However, he recognized the inadequacy of the d-output (I have no explanation for why he did produce 'byebye'). When he got the hang of saying b several months later, the long-inhibited words began to appear. The initial d's on most of them were caught and revised, but 'ball' escaped feedback scrutiny for a while, and was produced as [dɔ].

This notion of latent output representation is of course fascinating in its own right, but the significance of this story in the present context is that it is very strong evidence that deliberate avoidance of a too-difficult task is really involved in the observed phenomenon of selective avoidance.

Another point quickly made is that a child need not progress from 'coarse' to 'fine' or 'distinctive' to 'non-distinctive' features. In the present case, Jacob was having considerable trouble saying [ɔ] around 19 months, judging by the variability of his output, yet study of his error patterns showed that he was very aware of the difference in rounding between the [ɔ] of 'door', 'more', and the less rounded [ɔ] of 'walk', 'off', 'on'. When he 'missed' the rounded [ɔ], his substitutions were [o] or [u]; when he 'missed' the less rounded allophone, his errors were in the direction of [a] or [ʌ].

But Jacob's knowledge of [ɔ] at this stage when he missed it much more often than he hit it was not limited to knowing where it lay as a target. We have beautiful evidence that, at this period around 20 or 21 months, the vowel sounds, or at least the back vowel sounds, were more than a constellation of targets closer to or farther away from one another. Before Jacob went to work on saying [ɔ], he had only one back vowel of any stability, an [o] which appeared in 'uh-oh', 'toast', 'roll', 'nose'. But this [o] got disrupted at the time when Jacob started to say words with [ɔ], and the most frequent error (about half of the tokens of adult /o/) was the use of [u] for [o]--nose came out [nu], hole came out [hu]--although not stably. It seemed clear that Jacob related [ɔ] to [o] as being like [o] but lower, and in his attempt to capture this relationship, (since he had a hard time hitting that low back target), his formerly stable [o] was disrupted and pushed higher, towards [u].

I think that the story of [ɔ] makes it clear the phonemic structure in the classical sense can sometimes be grasped in detail before the acquisition of phonetic motor control over the phones in question. This is a very exciting result because it requires that the theory of the acquisition of phonology be enriched: in the face of such evidence, one cannot maintain that knowledge of the relationships between phones (higher than, more fronted than, etc.) always follows development of the ability to produce those phones as targets. Such a concrete approach--one like Olmsted's--would be very appealing to people in flat-out revolt against an abstract approach to the acquisition of phonology--and much of what I present here supports an anti-abstract approach--so I particularly want to emphasize the importance of the upwards displacement of [o] by [ɔ], which shows that abstract structure may sometimes be grasped before concrete phonetic knowledge.

Let me now turn to the topic of the function of rules of child phonology. Consider a younger child, a beginning speaker, coping with the problem of saying words. Such a child has, in general, a good deal of information about the sound of each word, but he cannot get his vocal tract to do all the things necessary to make what he says sound just like what he remembers. The task of saying words is even harder when the child is really concentrating on getting a meaning across.

Initially, children experiment with matching the sounds of some words; some of these experiments are successes both to the child's ear and as messages to adults. This is discovery; after initial discovery we find interaction: although some successes, some discoveries, remain isolated cases, phonological idioms (Moskowitz, 1971, 1973), a certain group of successes serve as the sources for general strategies which lead to new successes.

The most insightful description of the resulting output pattern is David Ingram's: he introduced to child phonology the notion of canonical form, and showed that beginning speakers tend to limit their output to a handful of such forms. (With exceptions--all grammars leak.) What does such a limitation buy for the child? Certainly not intelligibility--the amount of homonymity found in a child who represents a large set of adult words by a small set of canonical forms can be staggering. What having a limited output repertoire does for the child, it seems to me, is to help get the real-time production process streamlined, automatic, in less need of attention. Redundancy of the output lexicon, as I have termed it, is of value to the speaker; it means that he can use well-worn grooves, if you will, for saying most of his words.[1]

Now this is a teleological description. It is all very well to say that if a child has a small output repertoire, he will be able to achieve greater fluency, although at the cost of less intelligibility. That is like saying if a fawn has spots, it will be better camouflaged. Fawns do not develop their spots by experimentation and strategy formation, but I have been arguing that children form the phonological rules that yield the canonical form-dominated output in just such an active fashion. For the teleological explanation to be compatible with the interactionist-discovery theory, I must be able to argue either that the child has the reduction of output variety as a goal, so to speak, of rule formation, or else show that other factors influencing rule formation happen to conspire to produce this useful result. But if we review the data and analysis which I have so far presented, we can see that the needed arguments do indeed go through: reduction of output variety is a foreseeable result of the strategies we already know about.

In the case of rule formation by consolidation, the connection is obviously direct: some internal organizing force in the child is getting rid of output forms that are too close to others in some way; the output repertoire is directly reduced and sorted into neater piles.

In the case of rule formation by carryover generalization, the connection is indirect, but just as clear: exploitation of existing capabilities leads to the addition of new words resembling words already in the lexicon; not all cases of rule generalization will bring about reduction in the variety of output forms, but many will, and they are likely to increase output variety.

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[1]Note here especially the vowel metathesis rule developed by Vihman's subject in order to maintain her established vowel sequence pattern, (Vihman's paper, this volume).

The third major contributor to limited output variety, in a passive way, is slective avoidance. By avoiding words that do not match his output capabilities, the child keeps his output repertoire small without the use of rules.

There are thus three distinguishable ways that we know of in which beginning speakers deal with the problems of saying words,[2] and in one way or another each of them leads to the surface appearance of an output dominated by canonical forms.

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[2]Farwell's paper in this volume presents a fourth strategy. Not only is there avoidance of difficult sounds, but also an exploitation of well-mastered sounds. One might consider these two strategies related and range them along a scale from active (exploitation) to passive (avoidance), but the case of exploitation (use of 'favorite sounds') which Farwell presents is different enough from the cases of avoidance which we have mentioned that I would like to revise my original statement and to say now that there are four ways in which children arrive at the canonical-form-dominated output.

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